

IN THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

82. (Previously Presented) A photolithography tool comprising:
a light source outputting light for illuminating a reticle;
condenser optics positioned to receive light from said light source, said condenser optics positioned to direct an optical beam formed from said light through said reticle; and
projection optics configured to form an image of said reticle onto a substrate, said projection optics having an exit pupil, said projection optics including:

a first cubic crystalline optical element aligned along an optical axis, said first cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said exit pupil, said intrinsic birefringence of said first optical element having increased magnitude at a first set of lobes at a first set of locations arranged in an azimuthal direction about said optical axis;

a second cubic crystalline optical element aligned along said optical axis, said second cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said exit pupil, said intrinsic birefringence of said second optical element having increased magnitude at a second set of lobes at a second set of locations arranged in an azimuthal direction about said optical axis;

a third cubic crystalline optical element aligned along said optical axis, said third cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said exit pupil, said intrinsic birefringence of said third optical element having increased magnitude at a third set of lobes at a third set of locations arranged in an azimuthal direction about said optical axis,

wherein said first, second, and third cubic crystalline optical elements have a common lattice direction aligned parallel to said optical axis and said first, second, and third cubic crystalline optical elements have their respective crystal lattices selectively azimuthally rotated with respect to each other to reduce retardance over a substantial portion of said exit pupil, said first set of lobes being selectively azimuthally rotated with respect to said second set of lobes and said second set of lobes being selectively azimuthally rotated with respect to said third set of lobes such

that said first set of lobes, said second set of lobes, and said third set of lobes are oriented differently with respect to each other.

83. (Currently Amended) The ~~optical system~~ photolithography tool of claim 82, wherein said first, second, and third cubic crystalline optical elements comprise calcium fluoride.

84. (Previously Presented) The photolithography tool of claim 82, wherein first, second, and third cubic crystalline optical elements are selectively azimuthally rotated such that said second set of lobes is positioned about said optical axis at locations azimuthally offset from midway between the first set of locations of said first set of lobes and said third set of lobes is positioned about said optical axis at locations azimuthally offset from midway between the second set of locations of said second set of lobes.

85. (Currently Amended) The ~~optical system~~ photolithography tool of claim 82, further comprising a fourth cubic crystalline optical element aligned along said optical axis, said fourth cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said exit pupil, said intrinsic birefringence of said fourth optical element having increased magnitude at a fourth set of lobes at a fourth set of locations arranged in an azimuthal direction about said optical axis,

wherein said fourth cubic crystalline optical element has a crystal lattice selectively azimuthally rotated with respect to the crystal lattices of each of the first, second, and third cubic crystalline optical elements to reduce retardance over a substantial portion of said exit pupil, said fourth set of lobes being selectively azimuthally rotated with respect to said third set of lobes such that said fourth set of lobes are oriented differently with respect to said first, second, and third set of lobes.

86. (Previously Presented) The photolithography tool of claim 82, wherein said light source comprises a 248 nanometer light source outputting light having a wavelength of 248 nanometers for illuminating said reticle and said projection optics is substantially optically transmissive to light having a wavelength of 248 nanometers.

87. (Previously Presented) The photolithography tool of claim 82, wherein said light source comprises a 193 nanometer light source outputting light having a wavelength of 193 nanometers for illuminating said reticle and said projection optics is substantially optically transmissive to light having a wavelength of 193 nanometers.

88. (Previously Presented) The photolithography tool of claim 82, wherein said light source comprises a 157 nanometer light source outputting light having a wavelength of 157 nanometers for illuminating said reticle and said projection optics is substantially optically transmissive to light having a wavelength of 157 nanometers.

89. (Currently Amended) A method of fabricating an optical system having a pupil comprising:

disposing a first cubic crystalline optical element along an optical axis, said first cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said pupil, said intrinsic birefringence of said first optical element having increased magnitude at a first set of lobes at a first set of locations arranged in an azimuthal direction about said optical axis;

disposing a second cubic crystalline optical element along said optical axis, said second cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said pupil, said intrinsic birefringence of said second optical element having increased magnitude at a second set of lobes at a second set of locations arranged in an azimuthal direction about said optical axis;

disposing a third cubic crystalline optical element along said optical axis, said third cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said exit pupil, said intrinsic birefringence of said third optical element having increased magnitude at a third set of lobes at a third set of locations arranged in an azimuthal direction about said optical axis;

clocking said second cubic crystalline optical element with respect to said first cubic crystalline optical element such that said second set of lobes is selectively azimuthally rotated with respect to said first set of lobes;

clocking said third cubic crystalline optical element with respect to said first cubic crystalline optical element such that said third set of lobes is rotated about the optical axis

with respect to said first set of lobes, said third set of lobes and said second set of lobes being displaced by different amounts about said optical axis relative to said first set of lobes,

wherein said second and third cubic crystalline optical elements are clocked so as to reduce retardance over a substantial portion of said pupil.

90. (Currently Amended) ~~A~~ The method of claim 89, wherein said second and third cubic crystalline optical elements are clocked so as to minimize retardance over a substantial portion of said pupil.

91. (Currently Amended) ~~A~~ The method of claim 89, wherein said second and third cubic crystalline optical elements are clocked an amount optimized by a computer program.

92. (Previously Presented) A method of fabricating an optical system having an exit pupil, said method comprising:

disposing a first cubic crystalline optical element along an optical axis, said first cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said exit pupil;

disposing a second cubic crystalline optical element along an optical axis, said second cubic crystalline optical element having intrinsic birefringence that contributes to retardance in said exit pupil; and

orienting said first and second cubic crystalline optical elements such that said first and second cubic crystalline optical elements have respective crystal lattices selectively azimuthally rotated about the optical axis such that a substantial portion of said retardance contributed by said first cubic crystalline optical element is substantially orthogonal to a substantial portion of said retardance contributed by said second cubic crystalline optical element so as to substantially cancel and reduce retardance within the optical system.

93. (Currently Amended) An optical system comprising first and second cubic crystalline optical elements aligned along to a common optical axis, said optical system having an exit pupil, said first and second cubic crystalline optical elements each having intrinsic birefringence that contributes to retardance in said exit pupil, said intrinsic birefringence of said first cubic crystalline optical element having increased magnitude at a

first set of lobes at a first set of locations arranged in an azimuthal direction about said optical axis, said intrinsic birefringence of said second cubic crystalline optical element having increased magnitude at a second set of lobes at a second set of locations arranged in an azimuthal direction about said optical axis,

wherein said first and second cubic crystalline optical elements have respective crystal lattices selectively azimuthally rotated with respect to each other to reduce retardance over a substantial portion of said exit pupil, said selected azimuthal rotation positioning said second set of lobes about said optical axis at locations (a) azimuthally offset from the first set of locations of said first set of lobes and (b) azimuthally offset from midway between the first set of locations of said first set of lobes.

94. (Previously Presented) The optical system of claim 93, wherein at least said first cubic crystalline optical element comprises a [110] cubic crystalline optical element having a [110] crystal lattice direction substantially aligned with said common optical axis.

95. (Previously Presented) The optical system of claim 93, wherein at least said first cubic crystalline optical element comprises a [100] cubic crystalline optical element having a [100] crystal lattice direction substantially aligned with said common optical axis.

96. (Previously Presented) The optical system of claim 93, wherein said first and second cubic crystalline optical elements have a common lattice direction aligned parallel to said common optical axis.

97. (Previously Presented) The optical system of claim 93, comprising a [111] cubic crystalline optical element having a [111] crystal lattice direction substantially aligned with said common optical axis.

98. (Previously Presented) The optical system of claim 93, wherein said first and second cubic crystalline optical elements have shapes selected to reduce aberration at a wavelength of about 248 nanometers or less.

99. (Previously Presented) The optical system of claim 93, wherein said first and second cubic crystalline optical elements have shapes selected to reduce aberration at a wavelength of about 193 nanometers or less.

100. (Previously Presented) The optical system of claim 93, wherein said first and second cubic crystalline optical elements have shapes selected to reduce aberration at a wavelength of about 157 nanometers.

101. (Previously Presented) The optical system of claim 93 having a numerical aperture greater than 0.6.

102. (Previously Presented) A cubic crystalline optical system comprising:
at least two different cubic crystalline optical elements each having a different lattice direction aligned along a common optical axis, said two cubic crystalline optical elements having their respective crystal lattices selectively rotated with respect to each other and about the optical axis to reduce retardance within the optical system.

103. (Previously Presented) The cubic crystalline optical system of claim 102, wherein at least one of said at least two different cubic crystalline optical elements comprises a [100] cubic crystalline optical element having a [100] crystal lattice direction substantially aligned with said common optical axis.

104. (Previously Presented) The cubic crystalline optical system of claim 102, wherein at least one of said at least two different cubic crystalline optical elements comprises a [110] cubic crystalline optical element having a [110] crystal lattice direction substantially aligned with said common optical axis.

105. (Previously Presented) The cubic crystalline optical system of claim 102, wherein said at least two different cubic crystalline optical elements comprise a [110] cubic crystalline optical element having a [110] crystal lattice direction substantially aligned with said common optical axis and a [100] cubic crystalline optical element having a [100] crystal lattice direction substantially aligned with said common optical axis.

106. (Previously Presented) The cubic crystalline optical system of claim 102, comprising a [111] cubic crystalline optical element having a [111] crystal lattice direction substantially aligned with said common optical axis.

107. (Currently Amended) The cubic crystalline optical system of claim 102 having a numerical aperture greater than 0.6.

108. (Previously Presented) An optical system having intrinsic birefringence that imparts retardance on light propagated through said optical system, said optical system comprising:

a [110] cubic crystalline optical element having a [110] lattice direction aligned along an optical axis, and

a [100] cubic crystalline optical element having a [100] lattice direction aligned along said optical axis,

wherein said two cubic crystalline optical elements have their respective crystal lattices selectively rotated with respect to each other and about the optical axis to reduce said retardance associated with said optical system.

109. (Previously Presented) The optical system of claim 108 having a numerical aperture greater than 0.6.